

# Navy Personnel Research and Development Center

San Diego, California 92152-7250

AP-98-3

August 1998



## In-House Laboratory Independent Research (ILIR) FY97 Annual Report

Edited by Edmund Thomas

19980904 058

DTIC QUALITY INSPECTED 1

**In-House Laboratory Independent Research (ILIR)  
FY97 Annual Report**

Edmund Thomas  
(Editor)

Reviewed and approved by  
Murray W. Rowe  
Technical Director

Approved and released by  
W. M. Keeney  
Commander, U.S. Navy  
Commanding Officer

Approved for public release; distribution is unlimited

Navy Personnel Research and Development Center  
53335 Ryne Road  
San Diego, California 92152-7250

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is limited to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1998		3. REPORT TYPE AND DATE COVERED Admin. Publication—Oct 96-Sep 97
4. TITLE AND SUBTITLE In-House Independent Research (ILIR) FY97 Annual Report			5. FUNDING NUMBERS Center Overhead	
6. AUTHOR(S) Edmund Thomas (Editor)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research and Development Center 53335 Ryne Rd. San Diego, CA 92152-7250			8. PERFORMING ORGANIZATION AGENCY REPORT NUMBER NPRDC-AP-98-3	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Naval Research 800 North Quincy Street Arlington, VA 22217-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words)  This report documents 6.1 research efforts conducted at the Navy Personnel Research and Development Center (NPRDC) under the In-House Laboratory Independent Research (ILIR) program. The FY97 ILIR program included: A Conceptual Model of Drug Use; Diagnostic Tool to Improve Team Performance and Readiness; Response Inhibition Testing; and Assessing Navy Core Values Training Effects				
14. SUBJECT TERMS In-House Laboratory Independent Research (ILIR)			15. NUMBER OF PAGES 48	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED	

## Table of Contents

	Page
Introduction .....	1
<i>A Conceptual Model of Drug Use</i> .....	9
<i>Diagnostic Tool to Improve Team Performance and Readiness</i> .....	20
<i>Response Inhibition Testing</i> .....	22
<i>Assessing Navy Core Values Training Effects</i> .....	25
FY97 Program Summary .....	29
Appendix A - - Project Transitions .....	A-0
Appendix B - - Projects Terminated or Completed .....	B-0
Appendix C - - Presentations and Publications .....	C-0
Appendix D - - Project Awards and Honors .....	D-0
Distribution List	

## **INTRODUCTION**



## Introduction

Researchers at NPRDC are encouraged by the Technical Director to generate new and innovative proposals to promote scientific and technological growth in a broad range of disciplines supporting Navy manpower and personnel. These disciplines include cognitive science, behavioral science, operations research, information systems, and econometrics and statistics. The Office of Naval Research, through its In-House Independent Laboratory Research (ILIR) Program provides support for these initiatives.

ILIR funds encourage innovative investigations important to mission accomplishment. They enable selected researchers to spend a portion of their time exploring basic scientific issues needed for pioneering new technology relevant to the Navy and NPRDC's mission. The funds can provide an important and rapid test of ideas that help fill gaps in the research and development program and in the scientific knowledge base. They may also support preliminary work on issues considered too risky for funding through existing R&D programs.

ILIR funds also serve as a means of maintaining and increasing professional skills and building in-house expertise in thrust areas likely to become important in the future. ILIR research contributes to the scientific base for future improvements while providing a linkage to both the academic and industrial research communities.

The FY97 IR Program encompassed four projects across our mission areas of Workforce Management, Personnel and Organizational Assessment, and Training Technology. This was the final year in which the Center's mission included Training Technology. That portion of our mission was transferred to the Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, Florida, in early FY98 as directed by a BRAC-95 decision to realign functions and disestablish NPRDC. The two remaining mission elements, Workforce Management, and Personnel and Organizational Assessment, will be transferred to a new component of the Bureau of Naval Personnel (BUPERS), the Navy Personnel Research, Studies, and Technology (NPRST) Department, in early FY00.

**The FY97 IR Program.** The ILIR Program Cycle began with a call for proposals in July 1996. After review and endorsement by supervisors and department heads, seven proposals were submitted for funding consideration. A panel of three senior scientists reviewed the proposed efforts and recommended four projects for the FY97 program. After review by the Technical Director, the four projects were approved for funding. Two of these were continuations and two were new initiatives (see Table 1). This report documents results, accomplishments, and the current status of these projects. Table 2 summarizes projects supported by the ILIR program for FYs 95-97.

**Table 1**  
**ILIR Projects in the FY97 Program**

<b>Title</b>	<b>Status</b>	<b>PI and Code</b>	<b>DSN Phone</b>	<b>FY97 Funding</b>
Conceptual Model of Drug Use	Continuation	Borack, Jules (11)	553-7641	\$ 50,000
Group Norms & Readiness	Continuation	Cooper, Barrie (12)	553-7939	\$ 27,524
Response Inhibition Testing	New Start	Larson, Gerry (12) <sup>A</sup>	553-8402	\$ 47,486
Assessing Core Values Training Effects	New Start	Reynolds, Angelique (13) <sup>B</sup>	960-4373	\$ 38,110
<b>FY97 TOTAL</b>	<b>---</b>	<b>---</b>	<b>---</b>	<b>\$163,120</b>

<sup>A</sup>Gerry Larson transferred to the Naval Health Research Center, San Diego, CA, in November 1996.

<sup>B</sup>Angelique Reynolds transferred to the Naval Air Warfare Center Training Systems Division, Orlando, FL, in January 1998.



**Table 2**  
**ILIR Project Summary, FYs 95-97**

Title	Years	Funding			Total \$K Project
		FY95	FY96	FY97	
Optimizing Class Scheduling	2	45	48	--	90
Long Term Knowledge Retention	3	10 <sup>B</sup>	--	--	90
Training in Graphical Environments	2	40	47	--	87
Conceptual Model of Drug Use	3	48	52	50	150
Perceptual Motor Memory	(1) <sup>A</sup>	48	--	--	48
Group Norms & Readiness	2	--	25	27.5	52.5
Assessing Core Values Training	1	--	--	38	38
Response Inhibition Testing	(1) <sup>A</sup>	--	--	47.5	47
<b>TOTALS BY FISCAL YEAR</b>	<b>-</b>	<b>191</b>	<b>172</b>	<b>163</b>	

<sup>A</sup>Project was terminated during first year.

<sup>B</sup>Project was initiated in FY92.



**Independent Research  
Featured Report**



## FY97 ILIR Program

### Featured Report

The ILIR project highlighted in this report is *A Conceptual Model of Drug Use*, which was completed in FY97. This research resulted in one Technical Report, three journal articles and two conference presentations. The findings have immediate applications and potential payoffs for military drug detection programs as well as civilian drug screening and measurement. Summaries for the three remaining FY97 ILIR projects appear following the featured research project.

### *A Conceptual Model of Drug Use*

#### Introduction

The Navy's zero tolerance drug policy has been in effect since 1981. Since then the Navy has pursued an aggressive urinalysis testing program. The objectives of this testing program have been to deter and detect drug abuse, as well as provide data on the prevalence of drug abuse. All uniformed personnel are subject to random and other urinalysis testing on a continuing basis. The current policy (Chief of Naval Operations, 1994) includes the following:

1. Random urinalysis with 10 to 30 percent of a unit's personnel tested monthly at the direction of unit commanders without permission of higher headquarters.
2. More than 30 percent testing with permission of higher headquarters.
3. "Unit sweeps" of all personnel in the unit.
4. "Probable cause" urinalysis for specific incidents.

The program has been considered successful; the proportion of sampled service members testing positive for drugs has fallen from approximately 7 percent in 1983 to less than 1 percent in recent years. Responses from surveys of Navy personnel (Bray et. al., 1983, 1986, 1989, 1992, 1995; Burt et. al., 1980) parallel this decline. In 1980, approximately 33 percent of Navy personnel indicated they had used illicit drugs during the past 30 days; this had declined to less than 4 percent in 1995. Drug use percentages reported in surveys are expected to be of greater magnitude than positive test results since only a fraction of users are detected. Because of the effects of drug abuse on readiness, health, and safety, it is important that the Navy continue to evaluate and improve its drug testing program and seek to develop an optimal drug testing strategy.

Borack and Mehay (1996) developed a conceptual model for determining an optimal drug testing program. The model integrated the concepts of deterrence, detection and cost of drug abuse to establish a process for determining the relationship between the costs and benefits of drug testing. Figure 1 reproduces the conceptual model. Deterrence is assumed to occur first; undeterred users are then subject to detection. The productivity loss (or equivalently, lower value) of undetected and undeterred users represents the cost of drug use to the Navy. This cost can be compared to productivity loss that would occur if no testing were conducted in order to estimate the savings that result from drug testing. The cost of testing includes laboratory testing costs, the time required to participate in testing, and, optionally, the cost of replacing detected personnel. These costs can be compared to savings in order to estimate the net benefits of drug testing. Mathematical expressions were developed which estimated the proportion of individuals detected (Borack 1996a, 1996b,

1997) based on alternative monthly test rates. Based on the conceptual model, Borack (1996c) estimated the deterrence effect of testing. The deterrence effect was defined as the percentage decline in drug use from that which would occur if no testing were conducted. Figure 2 graphs the deterrence effect as a function of the monthly test rate. The function exhibits a classic diminishing returns pattern--higher levels of testing increase deterrence but at a decreasing rate. Borack and Mehay (1996) estimated that Navy drug use would be somewhat lower (approximately 9%) than corresponding civilian use even if there were no drug testing. This difference could be caused by self-selection or other aspects of Navy life.

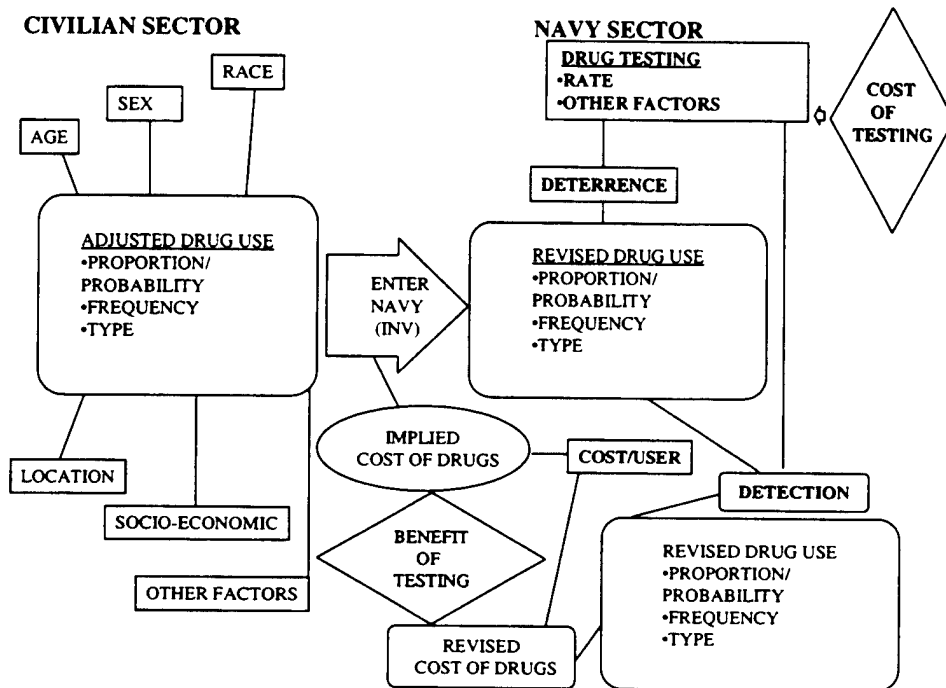


Figure 1. Conceptual model.

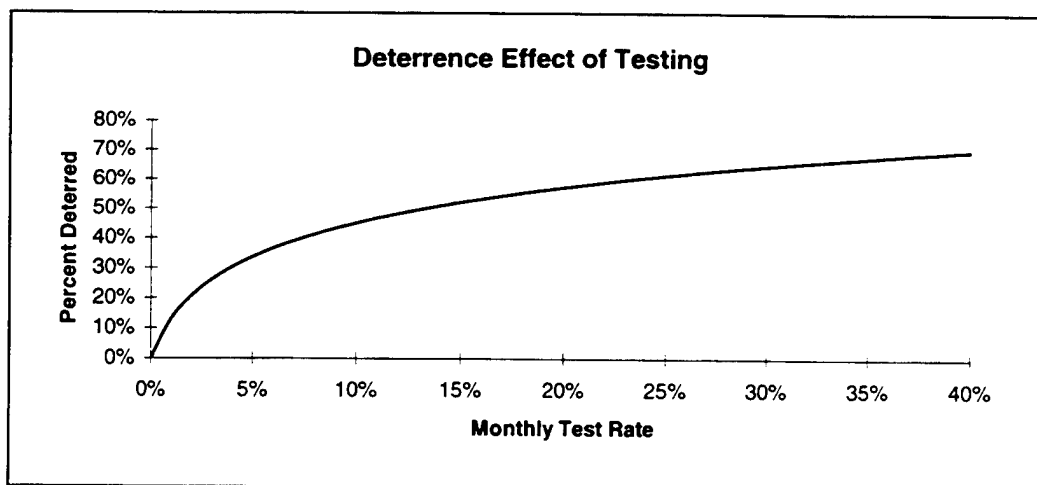


Figure 2. Deterrence effect of testing at alternative monthly rates.

## Objective

The objectives of this research were to (1) extend the model developed by Borack and Mehay to link improvements in urinalysis test sensitivity to the detection and deterrence of Navy illicit drug users and (2) estimate the deterrence and detection effects of tests of alternative sensitivity.

## Methodology

We define drug test sensitivity as the probability of obtaining a positive test result given the individual used illicit drugs; that is,  $Sensitivity = P(Positive\ test\ result \mid Individual\ used\ illicit\ drugs)$ . Borack and Mehay (1996) estimated monthly and annual probabilities of detection based on patterns of drug use from the 1992 Worldwide Survey of Substance Abuse and Health Behaviors Among Military Personnel (Bray, et al., 1992). These probabilities assumed that the vector of test sensitivity,  $S$ , was as follows:  $S = (1, 1, 0, 0, \dots, 0)$  where the  $i^{th}$  element represents the sensitivity of the test to drug use between  $i-1$  and  $i$  days prior to testing. According to  $S$ , drugs will be detected with certainty on the first and second day after use, but will not be detected beyond the second day. In general, we assume that elements of  $S$  are monotonically non-increasing, that is, as time elapses since drug use, detection probabilities decline or remain the same. Figures 3 and 4 graphically depict these probabilities. The probability of detection during a month is approximately linearly related to the monthly test rate while the probability of detection during a year exhibits diminishing returns. In order to escape detection during a year, an individual must remain undetected in each of its twelve months.

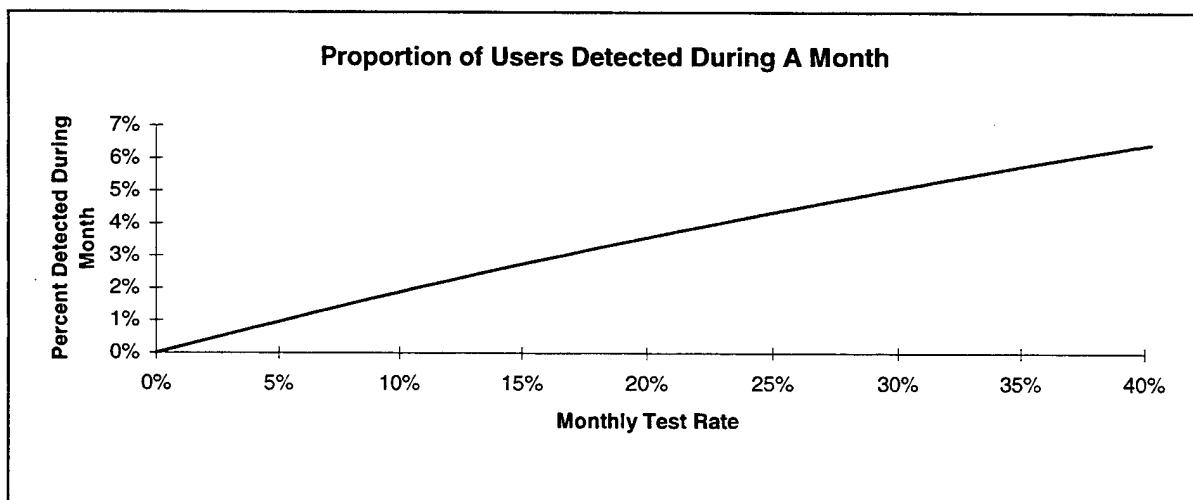


Figure 3. Probability of detection during a month as a function of the monthly test rate.

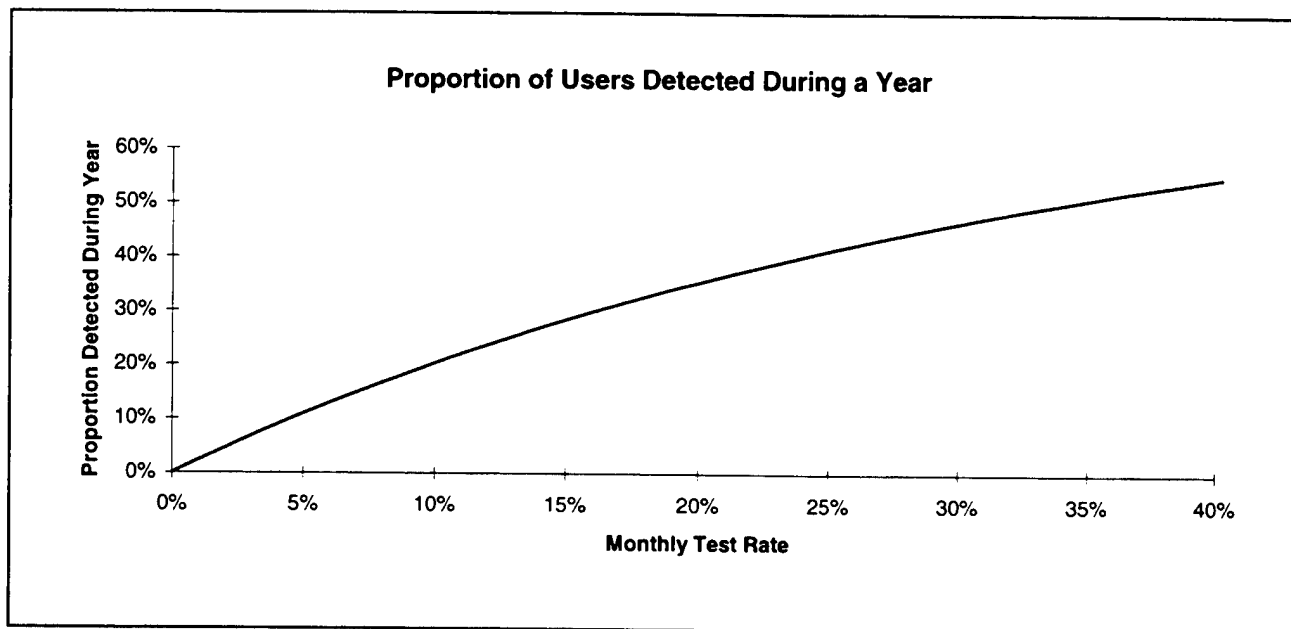


Figure 4. Proportion of users detected during a year as a function of the monthly test rate.

### Estimation of the Deterrence and Detection Effects of Testing

In order to estimate the deterrence effect of testing, Borack (1996c) estimated the proportion of personnel who would use drugs and the frequency of their drug use in the absence of testing. Let  $\eta_{30,0}$  represent the proportion of Navy personnel who would use drugs at least once during a 30-day period in the absence of drug testing. Estimates of  $\eta_{30,0}$  were constructed for 1980, 1982, 1985, 1988, 1992, and 1995 by demographically adjusting data from civilian surveys of drug use (Burt, et al., 1980) (Bray, et al., 1983; 1986; 1989; 1992; 1995). Estimates of  $\eta_{30,p}$ , the proportion of Navy personnel using drugs at least once during a 30-day period if the monthly test rate were  $p$ , were obtained directly from corresponding year surveys of drug use among military personnel (WWS) (Burt, et al., 1980) (Bray, et al., 1983; 1986; 1989; 1992; 1995), and are presented in Table 1. The column headed  $r$  represents the ratio of the number of laboratory tests to the corresponding annual inventory; the column headed  $p$  represents the corresponding average proportion tested during a month (monthly test rate).

Table 1  
Estimates of  $\eta_{30,0}$  and  $\eta_{30,p}$  for Fiscal Years 80, 82, 85, 88, 92, and 95

Fiscal Year	$\eta_{30,0}$	$\eta_{30,p}$	$r$	$p$
80	.363	.330	0.000	0.000
82	.270	.162	0.725	0.060
85	.244	.103	2.442	0.204
88	.150	.054	2.562	0.214
92	.105	.040	2.518	0.210
95	.100	.037	2.309	0.185



In order to estimate the relationship between the underlying test rate,  $p$ , and the deterrence effect, a logarithmic regression model was fit to the percentage difference ( $PDIFF$ ) between  $\eta_{30,0}$  (i.e., the proportion of drug users among an equivalent group of civilians) and  $\eta_{30,p}$  as a function of the logarithm of  $p$ , yielding the following parameter estimates:

$$PDIFF(p) = .878 + .172 \ln(p)$$

The value of  $p$  was scaled upward by one unit to avoid zero values. The corresponding values of adjusted  $R^2$  and  $F$  were .986 and 341.79, respectively, which were both highly significant. In order to estimate the deterrence effect of testing,  $DETER(p) = \frac{PDIFF(p) - PDIFF(0)}{1 - PDIFF(0)}$  was computed.

$DETER(p)$  represents the percentage difference between testing at rate  $p$  and not testing at all (i.e., testing at rate 0). Figure 2 graphically depicts this relationship. This function assumed that the test rate was the sole variable in estimating the deterrence effect of urinalysis testing. In this report, we assume that the test rate is not the only factor in deterring drug use. Instead, we assume the deterrence effect of testing is related to the probability of detection which is, in part, determined by the test rate. In summary, we assume the greater the ability of a testing procedure to detect a drug user, the greater will be its impact on deterrence.

As noted above, Borack and Mehay estimated monthly and annual probabilities of detection based on patterns of drug use from the 1992 Worldwide Survey of Substance Abuse and Health Behaviors Among Military Personnel (Bray, et al., 1992). Borack (1996a, 1996b) developed mathematical relationships for estimating the probabilities of detecting non-gaming and gaming drug users based on specific patterns of drug use and testing patterns. Non-gaming users were defined as individuals who choose their days of drug use without consideration of when testing might occur, while gaming users alter their drug use based on anticipated patterns of drug testing. Borack (1996a) shows that the probability of detecting a non-gaming drug user,  $P(DET)$  is:

$$P(DET) = 1 - \left(1 - \frac{m_r}{k}(\alpha)\right)^k \quad (1)$$

where  $m_r$  is the monthly test rate (e.g., 20%),  $k$  is the number of test days during the month, and  $\alpha$  is the probability of testing positive if selected for testing (which depends on the pattern of drug use and sensitivity of the test). Equations for estimating  $\alpha$  were also derived. For small values of  $\frac{m_r}{k}$ ,  $\left(1 - \frac{m_r}{k}(\alpha)\right)^k \cong 1 - m_r(\alpha)$ . Therefore, for small values of  $\frac{m_r}{k}$ ,

$$P(DET) \cong m_r(\alpha) \quad (2)$$

Borack (1996b) derived a methodology for estimating the probability of detecting gaming drug users. Based on the relative proportion of gaming and non-gaming users who use drugs a specific number of days per month, Borack and Mehay estimated the overall probability of detection as:

$$P(\hat{DET}_p) \cong .244p - .0417p^2 \quad (3)$$

where  $p$  represents the monthly test rate. Note that the probability of remaining undetected for the year is  $(1-P(\hat{DET}_p))^{12}$ ; therefore, the probability of detection during a year is  $1-(1-P(\hat{DET}_p))^{12}$ . Equation (3) assumed  $S = (1,1,0,0,\dots,0)$ . Table 2 lists the relative proportion of gaming and non-gaming users who use drugs a specific number of days per month as derived from Bray et. al., 1992 (see Borack & Mehay for further discussion). Assuming these relative proportions are consistent throughout the estimation period, Table 3 provides estimates of the probability of detection,  $P(\hat{DET}_p)$ , based on overall average monthly test rates. Table 3 also reproduces  $\eta_{30,0}$  and  $\eta_{30,p}$  from Table 1.

**Table 2**  
**Percentage of Navy Drug Users During the Past 30 Days by**  
**Frequency of Use and Gaming Strategy**

		Frequency of Use (Days During Month)									
		Gaming User					Non-Gaming User				
		1-3	4-10	11-19	20-27	28-30	1-3	4-10	11-19	20-27	28-30
Percent of Users		40.93	20.86	3.56	2.48	0.00	21.13	1.13	8.31	0.00	1.60

Source: Worldwide Survey of Substance Abuse and Health Behaviors Among Military Personnel, 1992.

**Table 3**  
**Estimates of  $\eta_{30,0}$ ,  $\eta_{30,p}$ , and  $P(\hat{DET}_p)$ , for Fiscal Years 80, 82, 85, 88, 92, and 95**

Fiscal Year	$\eta_{30,0}$	$\eta_{30,p}$	$P(\hat{DET}_p)$
80	.363	.330	.0000
82	.270	.162	.0146
85	.244	.103	.0479
88	.150	.054	.0502
92	.105	.040	.0494
95	.100	.037	.0437

In order to estimate the relationship between  $P(\hat{DET}_p)$  and the deterrence effect, a logarithmic regression model was fit to the percentage difference (*PDIFF*) between  $\eta_{30,0}$  (i.e., the proportion of drug users among a demographically equivalent group of civilians) and  $\eta_{30,p}$  as a function of the logarithm of  $P(\hat{DET}_p)$ , yielding the following parameter estimates:

$$PDIFF(p) = 1.456 + .293 \ln(P(\hat{DET}_p)) \quad (4)$$

The values of  $P(\hat{DET}_p)$  were scaled upward by .01 to avoid zero values. The corresponding values of adjusted  $R^2$  and F were .979 and 228.832, respectively, which were both highly significant. In order to estimate the deterrence effect of testing,  $DETER(p) = \frac{PDIFF(p) - PDIFF(0)}{1 - PDIFF(0)}$ , was computed. Figure 5 graphically depicts this relationship. As expected, the function exhibits diminishing returns, that is, deterrence increases but at a decreasing rate as a function of the detection probability.

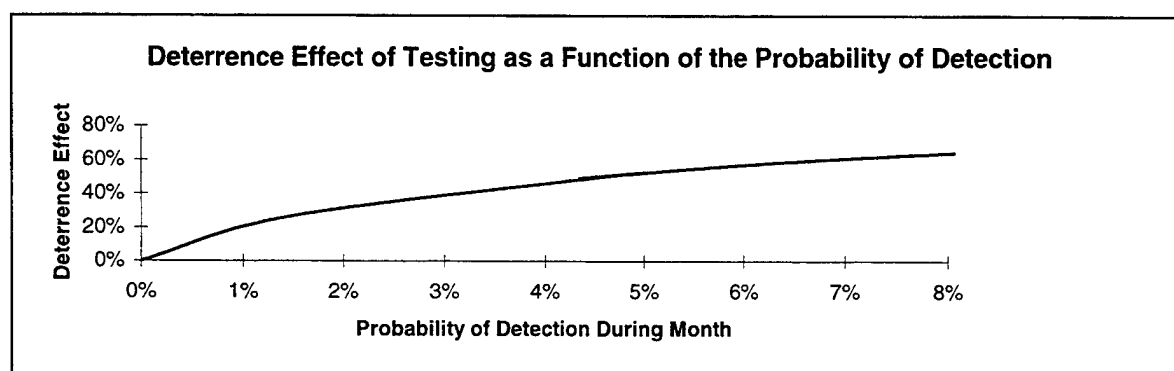


Figure 5. Deterrence effect of testing as a function of the probability of detection (during a month).

## Estimation of the Deterrence Effects for Alternative Test Sensitivities

The deterrence effects presented in Figure 5 were based on  $S = (1,1,0,0,\dots,0)$ . Suppose a new test with greater sensitivity is developed which doubles the length of time the drug is detectable, that is,  $S^\bullet = (1,1,1,1,\dots,0)$ . Alternatively, suppose a less sensitive test detects users during the original two-day time frame with only 50 percent probability, that is,  $S^{\bullet\bullet} = (.5,.5,0,0,\dots,0)$ . Under the same assumptions as discussed in the previous section,  $P(\hat{DET}_p)$  can be computed for these test sensitivities for specific monthly test rates. Table 4 presents these estimates of  $P(\hat{DET}_p)$  for various monthly test rates.

Fitting quadratic functions through the origin to the values obtained yields the following equations:

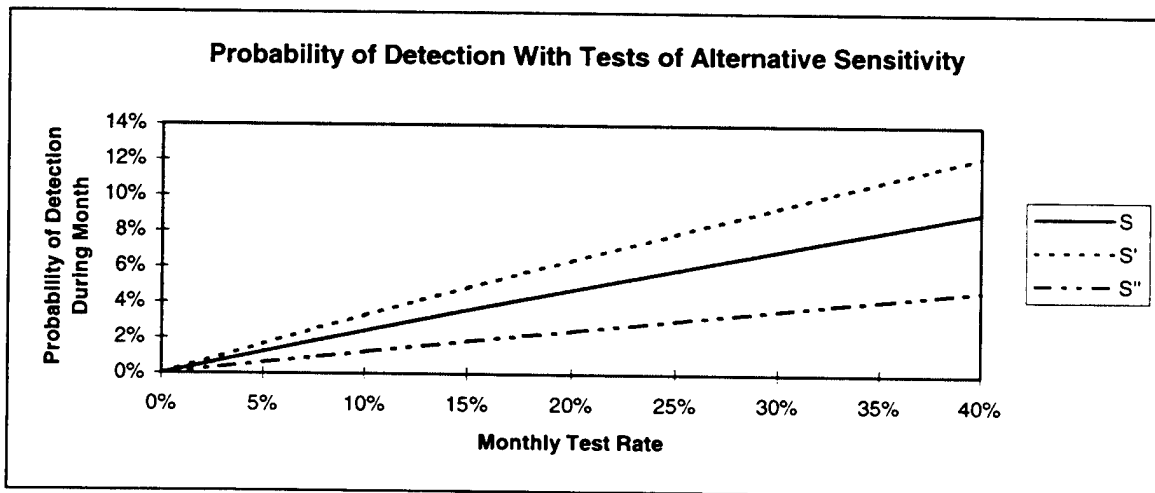
$$\text{For } S^\bullet, P(\hat{DET}_p) \cong .332p - .0641p^2 \quad (5)$$

$$\text{For } S^{\bullet\bullet}, P(\hat{DET}_p) \cong .123p - .0122p^2 \quad (6)$$

Figure 6 graphically represents  $P(\hat{DET}_p)$  for  $S$ ,  $S^\bullet$ , and  $S^{\bullet\bullet}$ . When compared to the baseline test, the probability of detection is discernibly higher for the more sensitive test and considerably lower for the less sensitive test.

**Table 4**  
**Impact of Monthly Test Rate and Test Sensitivity on Detection**

Monthly Test Rate ( $p$ )	Probability of Detection $S$	Probability of Detection $S^*$	Probability of Detection $S^{**}$
0.00	0.0000	0.0000	0.0000
0.05	0.0123	0.0167	0.0062
0.10	0.0242	0.0329	0.0122
0.15	0.0360	0.0488	0.0183
0.20	0.0474	0.0642	0.0242
0.25	0.0587	0.0793	0.0301
0.30	0.0697	0.0940	0.0359
0.40	0.0910	0.1224	0.0474
0.50	0.1115	0.1495	0.0586
0.60	0.1312	0.1754	0.0696
0.70	0.1502	0.2001	0.0803
0.80	0.1684	0.2238	0.0908
0.90	0.1859	0.2464	0.1011
1.00	0.2029	0.2681	0.1112



**Figure 6. Probability of detection of average drug user with tests of alternative sensitivity.**

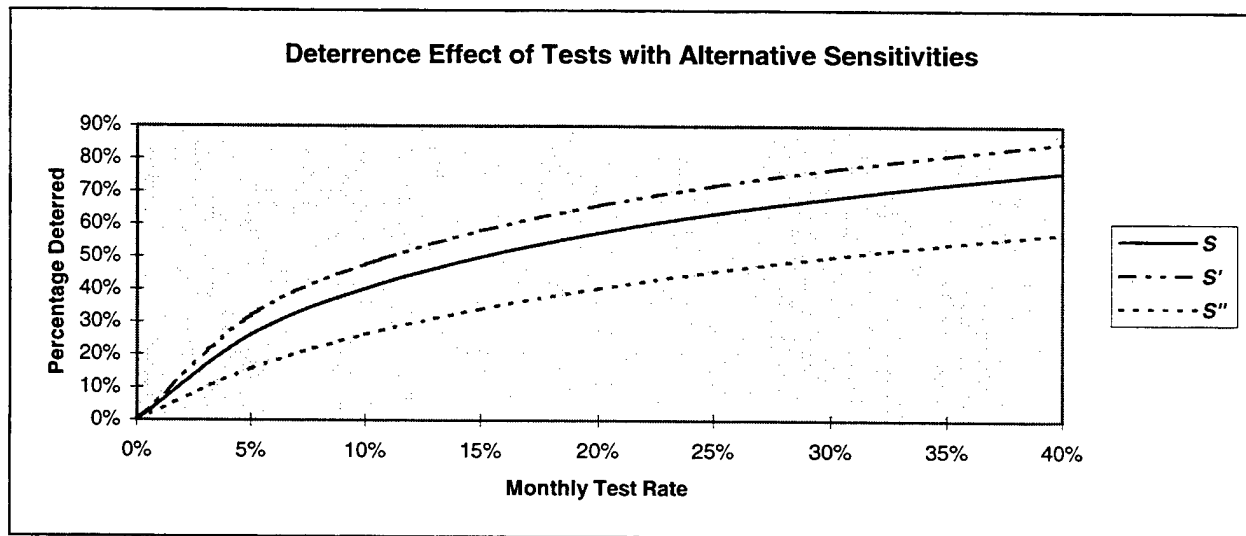
The next section compares the deterrence effect of these three tests.

## Results

Table 5 presents estimates of  $DETER(p)$  of tests with alternative sensitivity vectors,  $S$ ,  $S^*$ , and,  $S^{**}$  as previously defined. Estimates of  $DETER(p)$  are based on the values of  $PDIFF(p)$  computed from equation (4). Test sensitivity exerts a profound impact on deterrence. The test with double sensitivity yields approximately the same deterrence at a 15 percent monthly test rate as the baseline test at a 20 percent monthly rate. The test with only half the sensitivity requires approximately a 40 percent monthly test rate to achieve comparable deterrence. Figure 7 graphically illustrates these comparisons.

**Table 5**  
**Impact of Monthly Test Rate and Test Sensitivity on Deterrence**

Monthly Test Rate ( $p$ )	Proportion Deterred $S$	Proportion Deterred $S'$	Proportion Deterred $S''$
0.00	0.00	0.00	0.00
0.05	0.26	0.32	0.16
0.10	0.40	0.48	0.26
0.15	0.50	0.58	0.34
0.20	0.57	0.66	0.40
0.25	0.63	0.72	0.45
0.30	0.68	0.77	0.50
0.35	0.72	0.81	0.54
0.40	0.76	0.85	0.57



**Figure 7. Deterrence effect of tests with alternative sensitivities.**

Table 6 presents estimates per 1000 users of the number expected to be deterred or detected per month by selected combinations of test rate and test sensitivity. Table 6 was computed as  $(DETER(p) + (1 - DETER(p)) * P(\hat{DET}_p)) * 1000$  which represents the sum of the number of users deterred and the number of undeterred users detected per month. Table 7 presents a corresponding estimate of users deterred or detected per year and provides an estimate of the annual impact of drug testing. As can be seen in Table 7, testing with baseline sensitivity at a 15 percent monthly test rate corresponds to testing with approximately half this sensitivity at 30 percent. Doubling test sensitivity yields similar results for a bit more than 10 percent, or roughly a 50 percent decrease in the test rate. Thus, test sensitivity strongly affects the test rate required to achieve specific levels of deterrence and detection.

**Table 6**  
**Number of Users Deterred or Detected in a Month (Per 1000 Users)**

Monthly Test Rate ( <i>p</i> )	<i>S</i>	<i>S</i> •	<i>S</i> • •
0.00	0	0	0
0.05	269	330	162
0.10	416	492	270
0.15	516	599	352
0.20	592	678	417
0.25	652	739	471
0.30	702	789	517
0.35	744	831	557
0.40	780	866	592

**Table 7**  
**Number of Users Deterred or Detected Annually**  
**(Per 1000 Users)**

Monthly Test Rate ( <i>p</i> )	<i>S</i>	<i>S</i> •	<i>S</i> • •
0.00	0	0	0
0.05	361	442	216
0.10	553	647	362
0.15	675	768	470
0.20	760	844	554
0.25	821	895	622
0.30	865	929	677
0.35	898	952	722
0.40	923	968	761

## Conclusions and Recommendations

The sensitivity of drug tests strongly affected both the estimated probability of detection and the deterrence effect of testing. Compared to the baseline case, drug tests which double the period of detection not only increase the probability of detection of a typical drug user by approximately 1/3, but also deter an additional 9 percent of drug users. Borack and Mehay (1996) estimated the pool of potential Navy drug users to be approximately 40,000 individuals. Thus, testing at a 20 percent monthly test rate with baseline sensitivity can result in deterrence of approximately 22,800 users and an annual total impact (deterrence + detection) of 30,400. Doubling test effectiveness could deter 26,400 individuals and deter or detect 33,760 individuals; while decreasing test effectiveness by 50 percent could lower deterrence to 16,000 and diminish the annual total effect to 22,160 users. The model suggests that a test with baseline sensitivity administered to 20 percent of personnel monthly detects and deters users with approximately the same effectiveness as a test with double this test sensitivity administered to only 15 percent of personnel monthly. Similarly, a test with baseline sensitivity administered to 20 percent of personnel monthly detects and deters users with approximately the same effectiveness as a test that is 50 percent less sensitive which is administered to 40 percent of personnel monthly. Thus, there are profound tradeoffs between test sensitivity and test rate. Improvements in test sensitivity can greatly impact the effectiveness of a urinalysis testing program.

## References

- Borack, J. (1996a). *A technique for estimating the conditional probability of detecting a non-gaming drug user* (NPRDC TN-96-4). San Diego, CA: Navy Personnel Research and Development Center.
- Borack, J. (1996b). *A procedure for estimating the probability of detecting a gaming drug user* (NPRDC TN-96-5). San Diego, CA: Navy Personnel Research and Development Center.
- Borack, J. (1996c). *Costs and benefits of alternative drug testing programs* (NPRDC TR-96-8). San Diego, CA: Navy Personnel Research and Development Center.
- Borack, J. & Mehay, S. (1996). *A conceptual model for determining an optimal drug testing program* (NPRDC TR-96-5). San Diego, CA: Navy Personnel Research and Development Center.
- Borack, J. (1997, in press). A technique for estimating the probability of detecting a non-gaming drug user., *American Statistician*.
- Bray, R. M., Guess, L. L., Mason, R.E., Hubbard, R. L., Smith, D. G., Mardsen, M. E., & Rachal, J. V. (1983). *1982 worldwide survey of alcohol and nonmedical drug use among military personnel*. Research Triangle Park, NC: Research Triangle Institute. (RTI/2317/01/-01F).
- Bray, R. M., Mardsen, M. E., Guess, L. L., Wheelless, S. C., Pate, D. K., Dunteman, G. H., & Iannacchione, V. G., (1986). *1985 worldwide survey of alcohol and nonmedical drug use among military personnel*. Research Triangle Park, NC: Research Triangle Institute. (RTI/3306/06-02FR).
- Bray, R. M., Guess, L. L., Wheelless, S. C., Iannacchione, V. G., & Keesling, S.R. (1989). *1988 worldwide survey of substance abuse and health behaviors among military personnel*. Research Triangle Park, NC: Research Triangle Institute. (RTI/4000/06-02FR).
- Bray, R. M., Kroutil, L. A., Luckey, J. W., Wheelless, S. C., Iannacchione, V. G., Anderson, D. W., Mardsen, M. E., & Dunteman, G. H. (1992). *1992 worldwide survey of substance abuse and health behavior among military personnel*. Research Triangle Park, NC: Research Triangle Institute. . (RTI/5154/06-16FR).
- Bray, R. M., Kroutil, L. A., Wheelless, S. C., Mardsen, M. E., Bailey, S. L., Fairbank, J. A., & Harford, T. C. (1995). *1995 department of defense survey of health behaviors among military personnel*. Research Triangle Park, NC: Research Triangle Institute. (RTI/6019/06-FR).
- Burt, M. A., Biegel, M. M., Carnes, Y., & Farley, E. C. (1980). *Worldwide survey of nonmedical drug use and alcohol use among military personnel* (1980). Bethesda, M.D: Burt Associates.

## ***Diagnostic Tool to Improve Team Performance and Readiness***

### **Background**

The 1998 Department of the Navy Posture Statement states that, "Teamwork is an [important] Navy-Marine Corps trait. It ranges from teamwork within individual units, to cooperative efforts among units, to coordination throughout the Department of the Navy. The Navy and Marine Corps also can integrate forces into any joint task force or allied coalition quickly." This emphasis on the importance of teams reflects the Navy's increasing dependence on work teams in order to meet its commitments and achieve a high state of personnel readiness.

This increased emphasis on teams includes work teams and project teams, as well as ad hoc problem-solving and decision-making teams. In spite of this increased emphasis, our knowledge of the dynamics of teams and factors influencing their effectiveness is comparatively limited. Team research is inherently difficult because it involves variables derived from individual differences and collective behavior measures. Since the unit of analysis is ultimately the entire team, obtaining the numbers of participants needed for meaningful statistical analyses adds to the complexity of such research.

A specific problem in improving team effectiveness is the lack of diagnostic tools to determine which team characteristics need improvement to make the team more effective. Investigation of courses within DON and various team surveys reveals that neither trainers nor evaluators have any reliable means of diagnosing or predicting team performance. Those measures now used to assess team performance are insensitive to the underlying structural and process elements that influence team effectiveness.

Literature on team performance indicates that there are a sizable number of structural and process elements contributing to team effectiveness. Structural elements affecting team performance include member tenure and familiarity, team size, team structure, and degree of interaction among team members. Process elements that contribute to team effectiveness include group norms, group cohesiveness, group goals, person-group fit, and conformity. Few researchers have attempted to combine these constructs into a single, integrated model of team performance.

### **Objective**

The objective of this research is to develop and validate a Team Diagnostic Survey (TDS) which is (1) sensitive to team dynamics, strengths and weaknesses; and (2) an effective predictor of team performance. Once the survey and its underlying model have been validated, both should have immediate applications in the fleet. Assuming that the model predicts team performance adequately, feedback to commands and work teams will allow them to design and deliver training plans tailored to a team's needs. Information from the TDS should also suggest strategies for restructuring the team to make it more effective, thereby contributing to command readiness.



## Approach

A crucial need in improving team effectiveness is a better understanding of what team aspects can be improved to make the team more effective. Toward this end, the first step in this ILIR research was to conduct an extensive review of team dynamics, moderating variables, and outcomes. The remaining milestones focus on developing a pilot instrument, pilot-testing, initial validation, and administering the Team Diagnostics Survey to a broad spectrum of work teams.

The data collection involves approximately 100 military and civilian work teams across a wide range of Navy organizations.

Model development, survey development, and pilot-testing of the Team Diagnostic Survey occurred during the first year. Initial surveying began in FY97, and dual versions of some scales were developed in order to determine relative reliabilities and validities. During Phase II, scheduled for FYs 98-99, data is being collected from 50 additional teams. It is expected that the data from these 100 work teams will enable validation of the team performance model. During the entire data collection process, detailed feedback is being provided to the participating teams and their parent commands.

Organizations that use the feedback from the survey, either to conduct team training or to restructure the teams, will be given the opportunity to administer the survey a second time to determine the effectiveness of their retraining or restructuring. This will also allow a test of the survey's ability to measure changes in team structure and processes, and team performance, as predicted by the model.

## Status

The literature review, survey development and initial validation of the Team Diagnostics Survey (TDS) were completed during FY97. A central element of this TDS involves the concept of team norms--team member perceptions of expected team behavior, based on the expected positive or negative responses to that behavior by team members and supervisors.

Team norms provide a means of quantifying team behavior so that feedback can contribute to team effectiveness and performance. In addition, team cohesiveness, team goals, and person-team fit can be important predictors of performance. Several structural elements are also considered, including team member tenure and familiarity, team size, team structure, and team-member interdependence.

## Products

This research is expected to yield a diagnostic tool that will be useful to Navy commands that wish to improve the effectiveness and productivity of their work teams, resulting in increased readiness. Availability of the TDS as a diagnostic tool will enable commands to conduct team training or modify team composition to maximize the team characteristics that can improve team effectiveness.

## ***Response Inhibition Testing***

### **Background**

Response-inhibition refers to purposely suppressing a learned or automatic response.

If, for example, a person is instructed to not answer their telephone when it rings, a certain amount of response-inhibition is involved by the act of not picking up the receiver.

Response-inhibition tests are intended to measure how effectively subjects suppress such strongly ingrained actions or responses.

Individual differences on such tests seem to have important implications, because the inability to suppress (or inhibit) responses is linked to a surprisingly broad array of negative events, including misconduct, accident proneness, and mental illness. Moffitt (1993), for example, cites several studies showing delinquency-related impairments on inhibition tests. Apparently, delinquents have difficulty inhibiting inappropriate responses on command, a deficit that does not appear to be caused by either low IQ or low motivation. Rather, Moffitt attributes delinquency-related inhibition deficits to impaired executive functions such as planning and self-regulation.

Similar results have been found in adolescents and young adults with hyperactivity or attention deficit disorders. In such individuals, deficient inhibitory control is revealed by impulsive behaviors such as responding before the task is understood, answering before sufficient information is available, allowing attention to be captured by irrelevant stimuli (i.e., distractibility), or failing to correct obviously inappropriate responses (Schachar & Logan, 1990).

Along with disorders of adolescence, inhibition-deficits have also been linked with other adverse outcomes such as age-related cognitive declines, mental illness, and even accident-proneness. Thus, low response-inhibition is a "warning flag" for the presence of other cognitive or behavioral problems. It is conceivable, therefore, that response-inhibition, like intelligence, is a trait relevant to personnel assessment and vocational screening. This is particularly true when one considers that, in spite of current applicant screening procedures, the Navy is still forced to expel hundreds of recruits from A-schools each year for personality and conduct disorders, and sometimes for high-visibility criminal acts. Additional individuals are expelled from boot camp, and from the fleet.

Other evidence, however, precludes the near-term use of inhibition tests for personnel assessment. The primary obstacle is that the inhibition concept itself needs to be better defined and understood. For example, the above discussion is highly oversimplified in that it treats "response inhibition" as a single concept agreed to by all researchers in the field. In truth, however, response-inhibition is defined in many different ways, with little indication of how the various interpretations (and tests) might overlap. Thus far, there have been few attempts to demonstrate the fundamental integrity of the inhibition construct through convergent validity, i.e., a demonstration that independent methods can be used to measure the same thing (Campbell & Fiske, 1959).

## Objective

This project examines the characteristics of response-inhibition tests. One example is the Stop-Signal test, where subjects are instructed to rapidly press a key whenever a target is shown. On occasional trials, a signal to withhold the response is presented shortly before the target. Research has shown that some subjects have difficulty inhibiting a response, particularly when the interval between the stop-signal and the target is short.

This ILIR research has two objectives, to (1) develop a battery of response-inhibition measures; and (2) determine if there is a generic trait of response-inhibition and, if so, whether this trait correlates with standard personality and intelligence tests.

## Approach

The research design for this ILIR project called for three distinct phases of investigation:

- A literature review will be conducted in order to integrate various concepts of response-inhibition and identify a set of response-inhibition tests suitable for experimental administration.
- Measures of response-inhibition will be developed and their interrelationships will be determined, to explore the fundamental integrity of the inhibition construct. This phase employs a "convergent validity" approach, i.e., demonstrating that independent methods can be used to measure the same construct.
- The response-inhibition tests will be given twice, approximately one week apart, to determine test/retest reliability and assess their suitability for personnel selection. This test-retest design (on 150 subjects) will also determine the intercorrelations among various response-inhibition measures, and their relationships to personality, intelligence, and misconduct.

The results of the study will help to clarify the potential value of response-inhibition tests for personnel assessment.

## Status

This project was terminated in November 1997 due to the departure of the principal investigator. At that time the following steps were accomplished:

- The literature review resulted in identifying a set of eight response-inhibition (RI) tests for our experimental battery.
- Software programming was completed for four of the eight tests (the other four were either paper-and-pencil tests or off-the-shelf software).
- The eight RI tests were experimentally administered to 150 subjects along with additional measures of cognitive ability, personality, and self-report measures of misconduct. The eight RI measures were given twice to each participant (on separate days) to determine test/retest reliabilities.
- A database was created with all the data collected during the experiment.

Some preliminary analyses were undertaken, revealing low intercorrelations between RI measures. The findings support the contention that different researchers have defined response inhibition in quite different ways and thus, tests of the construct are quite heterogeneous.

### **References**

Campbell, D. T., & Fiske, D. W. (1959). Validation by the multitrait-multimethod matrix. Psychological Bulletin, 56, 81-105.

Moffitt, T. E. (1993). The neuropsychology of conduct disorder. Development and psychopathology, 5, 135-151.

Schachar, R., & Logan, G. D. (1990). Impulsivity and inhibitory control in normal development and childhood psychopathology. Developmental Psychology, 26, 710-720.

### **Principal Investigator**

Gerry Larson  
Naval Health Research Center  
P. O. Box 85122  
San Diego, CA 92186-5122  
Phone: (619) 553-8402  
Fax: (619) 553-8551

## *Assessing Navy Core Values Training Effects*

### **Background**

Recruit training is the service member's first experience with the Navy training system. As such, it should provide the skills and attitudes required for success in the modern Navy. Prior to entering training, today's recruit has been exposed to substantially different life experiences and values than the recruit of 20 or 40 years ago. Yet, few meaningful changes have been made in the way recruits are trained for their Navy careers since World War II.

In 1993, the Chief of Naval Operations convened a 'blue ribbon' panel to review all aspects of training at the Recruit Training Command (RTC) with the goal of developing specific recommendations for how it should be improved. One aspect of recruit training receiving the strongest attention from the panel was the treatment of "core values." The panel's recommendation called for greater emphasis on the role of core values throughout all levels of the Navy and Marine Corps, including RTC. By 1995, mandatory Core Values Training (CVT) modules were included in the RTC curriculum.<sup>1</sup>

CV Training has three objectives, to: (1) instill a consensual set of core values, (2) engender positive attitudes toward these values, and (3) result in positive changes in behavior. The Navy has also applied concepts of mentorship and individual stewardship to the RTC curriculum in order to promote the internalization of core values.

Mentorship of core values principles begins on Day One of the new Sailor's journey to the RTC. On that 1<sup>st</sup> day, the new recruit is met at the airport by a Recruit Division Commander and escorted to a bus within the first 45 minutes. While en route to the Great Lakes Training facility, the recruit views indoctrination videos and receives a "Blue Card" — designed to reassure new Sailors of the network of support around them — and a "Recruit Bill of Rights Card" — outlining the Navy's policy regarding discrimination and sexual harassment.

These curriculum changes reflect the Navy's broader goal of creating a climate of excellence, founded on an initial positive and reassuring experience. The ultimate goal of CVT is to send men and women to the fleet prepared to participate, contribute, learn, help and grow. Additionally, these initiatives reduce attrition and increase the foundation for future success in the fleet.

---

<sup>1</sup>The introduction of Core Values begins with the recruiting process. In the Navy, Core Values were the basis of the 1997 national advertising campaign; while the Marine Corps' emphasis focused on the transformation process. Both of these approaches are intended to ensure that young people who join the Navy and Marine Corps fully understand the services' expectations and are willing to serve at this level of excellence.

## Objective

The focus of this ILIR research project is in identifying technologies for evaluating the effects of CV Training. The technologies must be sensitive to small changes in personal values while being relatively immune to response bias, social desirability, and other factors external to the actual training.

## Approach

This ILIR research examines the effects of the Navy's Core Values Training on:

- (1) Accomplishment of assigned mission, and cost-benefits to the Navy;
- (2) An individuals' level of conviction in certain values; and
- (3) Changes in an individual's moral judgment.

Two alternative technologies are being explored, both using a computer-based interviewing system. The first is an unobtrusive self-report rating-scale designed to minimize an individual's tendency to respond in a socially correct fashion. The second technology, latency of response, involves an indirect measure of the underlying cognitive information processing associated with individual values.

It is hypothesized that the latency of response measure will enhance the sensitivity of direct attitudinal measures (self-reports) and lead to more accurate assessments of CV Training effects.

## Status

Work during the first year focused on:

- Thorough familiarization with the curricula and objectives of CVT;
- Observing the CVT in classroom situations;
- Identifying principles which result in enduring and measurable behaviors;
- Developing a checklist-interview protocol for assessing core values assimilation; and
- Identifying and selecting software for administering our instrument via computer.

In meeting these milestones the researcher observed RTC classroom training. She also audited the Navy Leadership Training Continuum (E-5, E-6, and E-7) courses to collect classroom dynamics data. Interviews were also conducted with training facilitators and school staff concerning the curriculum and its acceptance.

Based on a content analysis of the interview data, a rationale and protocol for building survey items was developed. The researcher then developed a computer-assisted interview on Core Values in Leadership targeted to enlisted personnel.

## **Products**

The immediate products of this research include a:

- Test of alternative technologies that control for social desirability while more accurately assess changes resulting from training;
- Prototype computer-based interview of the Navy Core Values Survey that employs a non-conventional self-report rating scale; and
- More accurate estimates of potential cost-benefits of this training to the Navy.

## **Transition Plans**

The Assessing Navy Core Values Training Effects project was transferred to NAWCTSD in FY98. Further progress will be included in the NAWCTSD FY98 ILIR Summary Report. This ILIR project has been integrated into a larger technology development effort within that Center to design and test alternative methods for assessing and tracking student performance during recruit training. The overall goal is to develop, test and evaluate innovative training and assessment instruments that can be administered in a variety of ways including delivery by computer.

### **Principal Investigator**

Angelique Reynolds

E-mail: angelique\_reynolds@ntsc.navy.mil

DSN: 960-4373 COM: (407) 380-4373





## **FY97 Program Summary**



## FY97 Program Summary

The FY97 ILIR program was funded at \$ 163K, distributed across four projects as follows:

Project	Status
<i>A Conceptual Model of Drug Use</i>	Completed; transitioned
<i>Group Norms and Readiness</i>	Continued into FY98
<i>Response Inhibition Testing</i>	Terminated; loss of PI
<i>Assessing Core Values Training Effects</i>	Transferred with PI



**APPENDIX A**  
**PROJECT TRANSITIONS**

## **PROJECT TRANSITIONS**

### **STATISTICAL MODELS**

Borack, J.

Conceptual Model of Drug Use

To: O&MN Supported projects for FY 98-00

— Defense Drug Testing Program

— Navy Drug World Wide Web

**APPENDIX B**

**PROJECTS TERMINATED OR COMPLETED**

**PROJECTS TERMINATED**

*Response Inhibition Testing,*

Larson, Gerry

**PROJECTS COMPLETED**

*Conceptual Model of Drug Use*

Borack, Jules



# **APPENDIX C**

## **PRESENTATIONS AND PUBLICATIONS**

## PROJECT PRESENTATIONS

Borack, J. (1997). *Techniques for Linking Testing Effectiveness and Time Dependencies into a Conceptual Model of Drug-Testing*. Institute for Operations Research and Management Science (INFORMS), February 1997, Monterey, CA.

Borack, J. (1997). *Techniques for Linking Testing Effectiveness and Time Dependencies into a Conceptual Model of Drug-Testing*. Western Economic Association (WEA), May 1997, Seattle, WA.

Borack, J. (1997). *Techniques for Linking Testing Effectiveness and Time Dependencies into a Conceptual Model of Drug-Testing*. Annual Meeting of the American Statistical Association, August 1997, Anaheim, CA.

Cooper, B. (1997) Group Norms and Readiness, Presented at the following Commands:

- Public Works Center, San Diego
- Shore Intermediate Maintenance Activity, San Diego
- Fleet Industrial and Supply Center, San Diego
- Afloat Training Group, Pacific
- San Diego Area TQL Coordinators
- Basic Underwater Demolition School (SEAL training)
- Prototype Division, Naval Air Weapons Station, China Lake

## PROJECT PUBLICATIONS

Borack, J. (1997). A Technique for Estimating the Impact of Drug Testing on Deterrence of Drug Use, *American Statistician*, 51(2) 134-136.

Borack, J. (1997) An Estimate of the Impact of Testing on the Deterrence of Drug Use, *Military Psychology*, 10(1) 17-25.

### Proceedings of Technical Meetings

Borack, J. (1998) a technique for estimating the impact of improvements in drug testing accuracy on detection and deterrence of illicit drug use by Navy personnel, *Proceedings of 1997 Annual Meetings of the American Statistical Association—Government and Social Sciences Section*, forthcoming.

**APPENDIX D**  
**PROJECT AWARDS AND HONORS**

**PROJECT AWARDS**

None

**PROJECT HONORS**

None

## **Distribution List**

Superintendent, Naval Postgraduate School, Monterey, CA  
Commanding Officer and Technical Director, Naval Medical Research and Development  
Command, Bethesda, MD  
Commanding Officer and Technical Director, Naval Air Warfare Center Aircraft  
Division, Patuxent River, MD  
Commanding Officer and Technical Director, Naval Surface Warfare Center, Coastal  
Systems Station, Dahlgren Division, Panama City, FL  
Commanding Officer and Executive Director, Space and Naval Warfare Systems Center  
San Diego, San Diego, CA  
Commanding Officer and Technical Director, Naval Surface Warfare Center, Dahlgren  
Division, Detachment White Oak, Silver Spring, MD  
Commanding Officer, Naval Underwater Systems Center, Newport, RI  
Commanding Officer and Technical Director, Naval Air Warfare Center Weapons  
Division, China Lake, CA  
Commanding Officer and Executive Director, Naval Air Warfare Center Training  
Systems Division, Orlando, FL  
Commanding Officer and Technical Director, Naval Surface Warfare Center, Carderock  
Division Detachment, Annapolis, MD  
Defense Technical Information Center (DTIC) (4)